


REVIEW ARTICLE
CHALLENGING TIMES

Maintaining health professional education during war: A scoping review

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Abstract

Purpose: War negatively impacts health professional education when health care is needed most. The aims of this scoping review are to describe the scope of barriers and targeted interventions to maintaining health professional education during war and summarise the research.

Methods: We conducted a scoping review between 20 June 2018 and 2 August 2018. The search was restricted to English publications including peer-reviewed publications without date ranges involving war and health professional education (medical school, residency training and nursing school), with interventions described to maintain educational activities. Two independent reviewers completed inclusion determinations and data abstraction. Thematic coding was performed using an inductive approach allowing dominant themes to emerge. The frequency of barrier and intervention themes and illustrative quotes were extracted. Articles were divided into modern/postmodern categories to permit temporal and historical analysis of thematic differences.

Results: Screening identified 3271 articles, with 56 studies meeting inclusion criteria. Publication dates ranged from 1914–2018 with 17 unique wars involving 17 countries. The studies concerned medical students (61.4%), residents (28.6%) and nursing students (10%). Half involved the modern era and half the postmodern era. Thematic coding identified five categories of barriers and targeted interventions in maintaining health professions education during war: curriculum, personnel, wellness, resources, and oversight, with most involving curriculum and personnel. The distribution of themes among various health professional trainees was similar. The frequency and specifics changed temporally reflecting innovations in medical education and war, with increased focus on oversight and personnel during the modern era and greater emphasis on wellness, curriculum, and resources during the postmodern era.

Conclusions: There are overarching categories of barriers and targeted interventions in maintaining health professional education during war which evolve over time.

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These may serve as a useful framework to strategically support future research and policy efforts.

1 | INTRODUCTION

Global conflict has dramatically increased since 2010, with two thirds of the world's extreme poor predicted to live in countries affected by crises such as fragility, conflict, and violence by 2030.¹ This includes countries in which the government cannot or will not deliver core functions to the majority of its people and countries affected by violent conflict including terrorism and war.² The impact of war on the health of a population is influenced in part by direct factors such as injuries and psychological trauma. Indirect factors, such as increased disease, malnutrition, and diminished access to care, medications and basic necessities, are other contributors.³ These indirect factors are exacerbated by damage to health care facilities, increasing violence directed toward medical personnel, collapse of health care delivery systems, and infrastructure degradation.^{4,5} War critically disrupts both access to medical care for affected populations and local education systems that train future health care providers.⁶ Like other crises, war often leads to delays, reduction, or complete cessation of health professional education and training programmes with a subsequent exodus of qualified health professionals from the country.⁷ Beyond their health care expertise, many of these professionals serve as community leaders and contribute to local economic recovery and political stability.⁸

Maintaining adequate numbers of health professionals is crucial to meet the health care needs of a given population.⁹ During war, it is imperative to address the increased need for medical professionals inherent in these situations.¹⁰ Health professional education is key to producing a workforce of providers vital to maintaining and repairing a health care system. Given the complex interplay of these factors, civilian suffering and the public health impacts from conflicts extend well beyond the period of active warfare.¹¹ Compounding this, many in the countries undergoing conflict are disadvantaged by preexisting low numbers of health professional schools and educators.¹² Strategic efforts to maintain health professional education during wartime may help mitigate provider shortages and improve the health of affected populations not only during the conflict but in the transition and developmental stages that occur post-conflict.⁶

Research on the impact of specific conflicts on health professional education as well as general overviews describing the effect of conflict on medical education is described.¹³ There is, to our knowledge, no scoping or other systematic review fully characterising the available literature regarding the barriers to maintaining health professional education during war and the interventions used to overcome these hardships. Subsequently, there is a paucity of data available to design effective strategies for maintaining health professional education during war and scant research on how to rebuild health education systems once wartime crises have stabilised. These aggregated data have the potential to inform research, policies, resource allocation, and health

professional educational practices in countries enduring war. Therefore, a comprehensive review and understanding of the current body of literature are a critical first step to address this knowledge gap.

A scoping review is a 'preliminary assessment of potential size and scope of available research literature' and it 'aims to identify nature and extent of research evidence (usually including ongoing research)' and does not include quality assessment.¹⁴ The literature on maintaining health professional education during war is inherently complex and heterogeneous in nature and therefore more suitable to this type of broader, more comprehensive review.

A scoping review was conducted with specific aims to (1) describe the scope (i.e., amount, focus and nature of research) of barriers and targeted interventions to maintaining health professional education during war and (2) summarise research results in order to identify existing gaps in knowledge to better inform future research and policy development. These findings can also guide educational leaders, international aid agencies, and donor organisations to optimise support to effectively maintain health professional education efforts during times of war.

2 | METHODS

A scoping review was conducted using similar methodology as a systematic review in order to maintain the same level of rigorous and transparent methods for data collection, analysis, and interpretation. The main phases of this review were as follows: (1) search for relevant studies; (2) select studies based on inclusion and exclusion criteria; (3) extract data and (4) collate, summarise, and report results.

A research protocol was established prior to conducting this research. The preferred reporting items for systematic reviews and meta-analysis (PRISMA-ScR) guidelines were followed in writing the manuscript.¹⁵ The following research questions were formulated: (1) What categories of barriers and targeted interventions have been described for the continuation of medical education during war for health care professional trainees? (2) Have any of the targeted interventions for continuation or completion of medical education efforts been validated in subsequent wars? (3) To what degree have barriers and interventions varied between different types of health care professional trainees? (4) Are there temporal differences in barriers and interventions due to the evolution of medical education and changes in the conduct of war?

2.1 | Definitions

The health care professional trainees were defined as medical students, medical residents in training, and nursing students by the

authors for the purposes of this study. Pharmacists, dentists, midwives, and other allied health professionals were not included in this study given the large number of potential health professional trainees making it too broad for this review. War was defined as human induced armed conflict between or within a group of people. We did not include crises caused by natural disasters (e.g., earthquakes, hurricanes, drought, or other meteorological events). The educational interventions were defined as curriculum creation or modification, established or novel teaching methods, instruction, assessment, or evaluation. The continuation of education was defined as those students in a programme granting a medical degree (undergraduate medical education), nursing degree, or completing residency training (graduate medical education).

2.2 | Search strategy

Inclusion and exclusion criteria were defined for the literature search. Inclusion criteria included: English language, peer reviewed manuscripts involving a war that disrupts degree granting programmes for health professional education including undergraduate medical education, graduate medical education (residency training), and nursing school. An intervention, programme, or adaptation regarding either continuation of training or the ability to complete training must have been described. There was no date range established, and articles were included up to the date the study began in June 2018. Exclusion criteria included non-English language, grey literature or lay press as not peer reviewed, natural disasters, irrelevant topics, and nursing or physician continuing medical education or continuing professional development. The following databases were searched: PubMed, EMBASE, and ERIC. Search terms were determined by consensus with librarian assistance from the Countway Library at Harvard Medical School, and the search strategy for PubMed is included in Appendix S1.

2.3 | Study selection

Covidence systematic review software (Veritas Health Innovation, Melbourne, Australia www.covidence.org) was used as the data abstraction tool. A total of 3271 abstracts or articles from the database searches were found to be potentially relevant based on the search and Medical Subject Headings (MeSH) terms. This was an iterative process with several searches conducted with refining of terms by the authors. Two team members independently reviewed each abstract (or full article) to determine if it met all inclusion criteria. The reviewers used the inclusion and exclusion criteria to determine if the article was included, excluded, or needed further determination. For any article that was deemed to 'need further determination', two independent reviewers reviewed the full article to determine inclusion or exclusion. Where disagreement occurred, an additional independent reviewer was recruited, and a final decision on inclusion was made by consensus.

2.4 | Review of eligible articles

The study team used Covidence to create a data abstraction tool to extract descriptive and qualitative data from each article. Categories included country; date of conflict; type of conflict; duration of conflict; category of trainee (nursing student, medical student, and medical resident); barriers to training as they affected the trainee subcategories; and interventions to maintain training for the trainee subcategories. Study data were then extracted from Covidence and managed and analysed using REDCap (Research Electronic Data Capture) electronic data capture tools hosted by Partners HealthCare Research Computing, Enterprise Research Infrastructure & Services (ERIS) group. REDCap is a secure, web-based application designed to support data capture for research studies.¹⁶

2.5 | Collating, summarising and reporting the results

We conducted a thematic analysis of the qualitative data using an inductive approach that allowed dominant themes to emerge.¹⁷ Two independent study team members reviewed the majority of the articles to familiarise themselves with the data. Initial codes were generated from the articles, and based on these codes, themes were deduced. The articles and codes were then re-reviewed for themes across all articles and further defined with the frequency of appearance of each theme calculated and illustrative quotes extracted. Articles were then divided into two categories to permit temporal and historical analysis: the modern era (World War II and preceding wars) and the postmodern era (post World War II wars). The thematic differences between the two categories were analysed to assess how the barriers to, and interventions for maintaining medical education (e.g., training duration, accelerated pathways, competency assessments, and medical technology) and types of conflicts and conduct of war evolved over time.

The grant funder of this study had no role in study design, data collection, data analysis, data interpretation or writing of the manuscript. The corresponding author had full access to all the study data and had final responsibility for the decision to submit for publication. The Institutional Review Board at our institution approved this study.

3 | RESULTS

3.1 | Search strategy, study selection, and data extraction

We identified a total of 3271 articles through the initial database search, with no additional articles added through hand-searching. After removing duplications and conducting abstract screening, 196 studies were evaluated for inclusion based on full-text review, with 56 studies meeting final inclusion criteria. A summary of the selection of articles is provided in a PRISMA flow diagram in Figure 1. Detailed information of included articles is provided in Figure 2 and Appendix S2.

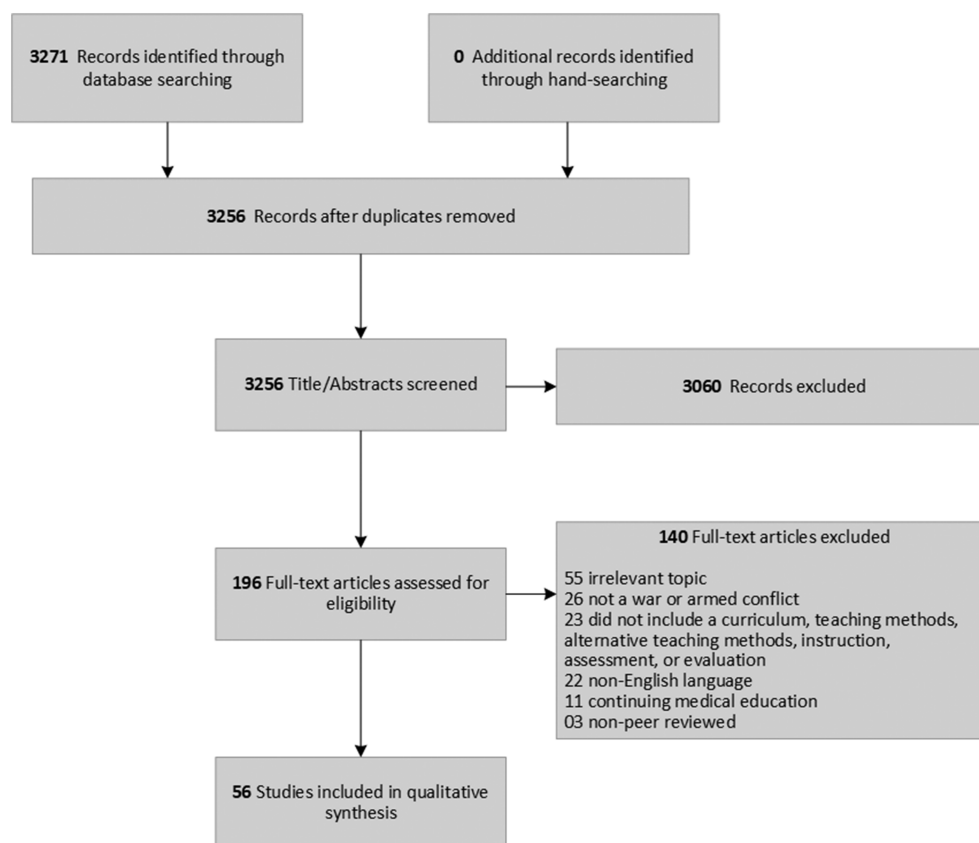


FIGURE 1 PRISMA flow diagram of screening and selection process

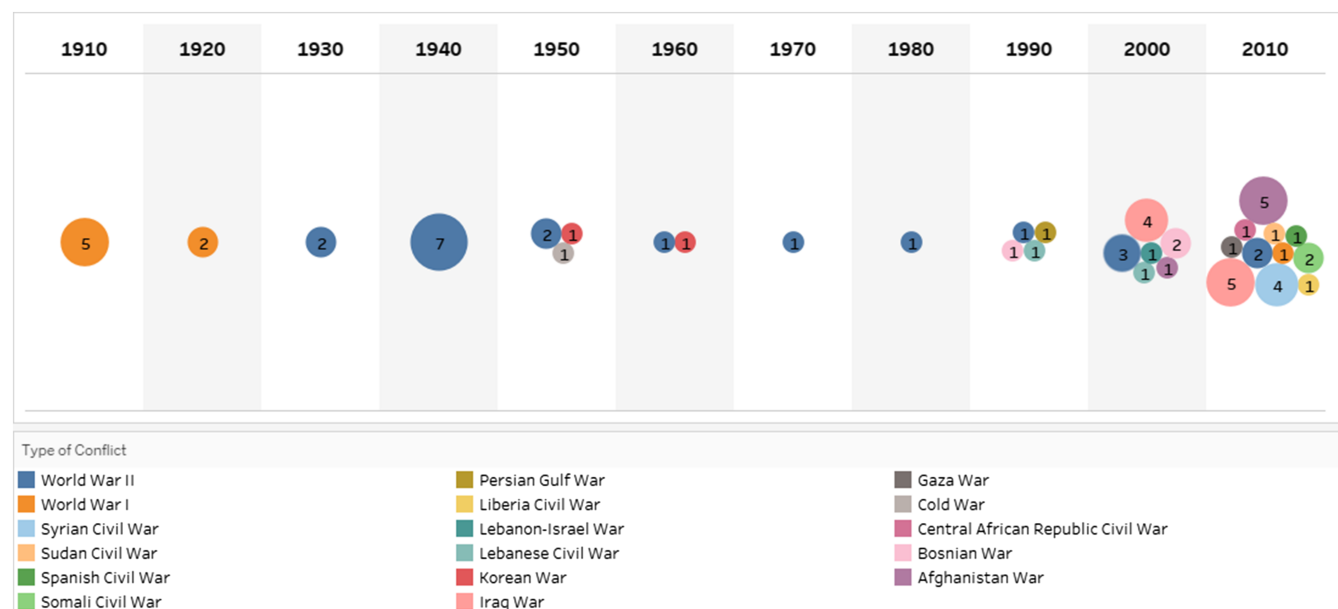


FIGURE 2 Types of conflict and publication dates of articles included in the scoping review [Color figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com)]

TABLE 1 Types of barriers and interventions to maintaining education during war among health professional students

Role	Barriers- category	N ^a	Percentage ^b	Interventions- category	N ^a	Percentage ^b
Medical Students	Curriculum	30	70	Curriculum	36	84
	Personnel	26	60	Personnel	22	51
	Wellness	23	53	Wellness	6	14
	Resources	24	56	Resources	21	49
	Oversight	13	30	Oversight	17	40
Residents	Curriculum	14	70	Curriculum	15	75
	Personnel	6	30	Personnel	3	15
	Wellness	6	30	Wellness	4	20
	Resources	4	20	Resources	4	20
	Oversight	4	20	Oversight	4	20
Nursing Students	Curriculum	2	29	Curriculum	7	100
	Personnel	5	71	Personnel	2	29
	Wellness	2	29	Wellness	1	14
	Resources	4	57	Resources	3	43
	Oversight	4	57	Oversight	3	43

^aN is the number of studies including each barrier or intervention theme.

^bPercentage of total number of studies per trainee type that included each barrier or intervention.

3.2 | Descriptive summary of research on interventions and barriers

3.2.1 | Characteristics of studies identified

Most of the studies involved medical students (61.4%), followed by residents (28.6%), and nursing students (10%). The publication dates ranged from 1914 to 2018 with 17 unique conflicts described involving 17 different countries (Appendix S3 and Figure 2). Half the analysed studies (28) involved modern era conflicts and half (28) involved postmodern era conflicts with detailed information of included articles provided in Appendix S2 and Figure 2.

3.2.2 | Focus of research on interventions and barriers

Through thematic coding, five distinct categories of barriers and targeted interventions were identified in maintaining health professions education during conflict: curriculum (e.g., adapted, new, and context specific), resources (e.g., books, classrooms, equipment, and clinical exposure), personnel (e.g., physical presence of students, faculty, supervisory instructors, and administrators), wellness (e.g., mental or physical wellbeing, post-traumatic stress disorders, and coping strategies) and oversight (e.g., accreditation body, governance, administration, and certification). The prevalence of these themes is displayed in Table 1. Overall, most barriers and targeted interventions were related to an education strategy (e.g., adaptations in the curriculum, duration of training, and quality of instruction) and personnel (e.g., lack of faculty, quality of faculty, and recruitment of students or trainees). Each theme was coded for descriptions of both barriers and

targeted interventions. Illustrative quotations for each theme are displayed in Table 2.¹⁸⁻³⁷

Barriers involving the curriculum included time constraints,^{20,27} lack of expertise with wartime topics,³⁰ decreased training in civilian topics such as primary and preventative care,^{18,38-40} and lack of standardisation and quality of the curriculum.^{41,42} The interventions implemented included shortening of training time such as eliminating summer vacations or planned breaks and opening new schools.^{18,21,32,43-46} Many countries adapted their curricula to integrate the management of war casualties, trauma care, infectious diseases, and mental health.^{27,29,41} Residency training programmes were adapted to address military needs such as increased demand for anaesthesia and surgical training programmes.^{19,30,39} There were educational advances in clinical care and surgical specialty development (e.g., trauma surgery and neurosurgery), along with research (e.g., advances in wound care and new operative techniques) and health professional development.^{38,41} More recent interventions included the use of telemedicine and web-based educational platforms to address gaps in faculty expertise and clinical experience.^{34,42}

Disruptions in access to educational resources such as supplies, teaching materials, and infrastructure were a common theme throughout the literature. Common barriers identified were the destruction of classrooms and buildings from direct and indirect bombing and targeting,³³ as well as the loss of textbooks, laboratory equipment and facilities, and clinical sites for patient care.^{23,25} Interventions described included moving to less dangerous alternative locations for instruction such as underground or secret facilities, remote cities, or even moving students to other countries.^{26,47} In recent conflicts, online resources have been more accessible, allowing for remote learning and access to educational materials. These innovations, however, require updated computer technology and consistent access to the internet.^{31,48}

TABLE 2 Illustrative quotations of barriers to and interventions for maintaining health professions education

Category	Percentage ^a	Subcategories	Illustrative quotations	Conflict	Country ^b
Barriers					
Curriculum	70%	Loss of opportunities	‘Young physicians who would normally have been in training for the various specialties of medicine have gone into the armed forces The clinical experience of most medical officers in the Army and the Navy is very limited in scope and radically different from civilian medical care’. ¹⁸	World War II	United States
Personnel	59%	Faculty	‘... At least one and often two faculty members have been gone almost continuously. From the perspective of a trainee, faculty deployments meant changes in didactics, supervision assignments, and lost opportunities to be mentored by the deployed faculty member’. ¹⁹	Iraq War, Afghanistan War	United States
		Students	‘The quality of students was poor because most of them apparently went into medicine only because they wanted to get out of the army and to avoid the hardships and dangers of frontline duty’. ²⁰	World War II	Germany
Wellness	46%	Safety	‘All villages and suburbs east, north, and south of Osijek were occupied, and the city lived through daily air raids that left dead and wounded everywhere. The faculty at the Zagreb Medical School had to decide whether it could continue its branch medical schools under such precarious circumstances’. ²¹	Bosnian War	Croatia
		Psychological	‘The most common feelings reported were “nervous,” “stressed,” “agitated,” and/or “on edge”’. ²²	Gaza War	Israel
		Health	‘Nutritional conditions were so poor that they had to struggle against starvation The incidence of tuberculosis among them ran up in some places Students not infrequently succumbed to disease and death before they could finish their course’. ²³	World War II	China
Resources	52%	Supplies	‘Laboratory facilities and classrooms are usually poorly equipped and outmoded. Most college buildings are not purpose-built. Even the library in the flagship University of Baghdad school is now usually without electric service’. ²⁴	Iraq War	Iraq
		Infrastructure	‘Like everything else in that compressed, strangling world, the hospital system of the Warsaw ghetto was complex, patched-together, inefficient, and overstrained’. ²⁵	World War II	Poland
Oversight	27%	Government	‘Enlightenment and learning were the primary targets of the Nazis The universities were closed, and professors and academic teachers were arrested and deported to concentration camps, where many of them perished. The light of education seemed to be extinguished’. ²⁶	World War II	Poland
		Military	‘We should keep one point clear in our minds and make it clear to the students. Medical students are not exempted from the draft law. They are actually in military service in accordance with the regulations under that law’. ²⁷	World War I	United States
Interventions					
Curriculum	86%	Curriculum structural changes	‘The medical schools of this country have volunteered to increase enrollments as much as	World War II	United States

TABLE 2 (Continued)

Category	Percentage ^a	Subcategories	Illustrative quotations	Conflict	Country ^b
			their facilities will permit and to accelerate the graduation of physicians by discontinuing summer vacations for the duration of the war'. ²⁸		
		Focus on wartime topics	'... The traditional training emphasis on perioperative management of surgical patients would be necessarily compressed. However, this same situation could provide the opportunity for intense exposure to acute resuscitative and operative phase of trauma patient care'. ²⁹	Persian Gulf War	United States
		Research and medical innovation	'Another often overlooked yet indispensable influence [...] concerned providing a basis for a more systematic method of neurosurgical training This served as the first time an attempt was made at standardising neurosurgical training'. ³⁰	World War I, World War II	United States
		New opportunities	'Students were exposed to hundreds, if not thousands, of patients with wide range of war-related medical conditions This enhanced students abilities to perform under pressure and widened their spectrum of knowledge to a large extent'. ³¹	Syrian Civil War	Syria
Personnel	46%	Recruitment	'... They determined to meet the emergency by increasing as rapidly as possible the number of pupil nurses in hospitals, pushing them forward and if necessary graduating them earlier, so that there would be a steady and increasing supply of trained women for the more responsible and difficult work overseas and at home'. ³²	World War I	United States
Wellness	18%	Psychological	'There were significant efforts, particularly by the trainees, to strengthen social relationships and enhance a sense of belonging Group engagement of the faculty and residents were closely monitored to identify individuals who may need additional support'. ¹⁹	Iraq War, Afghanistan War	United States
Resources	45%	New buildings and locations	'Each medical school implemented its own evacuation plan and students found themselves immediately dispatched from their teaching hospitals, almost all of which were situated in busy, urban districts—some, indeed, in the heart of the London slums—to safer areas, that were suburban or relatively rural'. ³³	World War II	England
		New supplies	'We report the use of a dedicated web-based portal Trainees are able to upload clinical cases to be discussed with a U.K.-based tutor; tutors are then able to question trainees in real-time and highlight areas requiring attention, simulating the bedside teaching experience'. ³⁴	Somali Civil War	Somalia
		Fundraising	'... Because of a grant from the World Bank and other generous donations, a security fence for the Medical School has been built, and laboratories, classrooms and administrative offices are being constructed'. ³⁵	Liberian Civil War	Liberia
Oversight	39%	Government	'The enforcement of regulations of the Surgeon-General, in carrying out the selective service regulations, was not only useful in maintaining the accepted standards of medical education,	World War I	United States

(Continues)

TABLE 2 (Continued)

Category	Percentage ^a	Subcategories	Illustrative quotations	Conflict	Country ^b
			but resulted in the discontinuance of a few of the poorest schools'. ³⁶		
		Military	'Since the majority of students were under control of the Army, they had many interruptions associated with military training and Nazi Party functions'. ³⁷	World War II	Germany

^aPercentage of total number of articles including each barrier or intervention.

^bCountry of authorship of quote.

Our review demonstrated barriers to psychological wellness, including feelings of isolation and increased depression among trainees.^{22,48} Interventions included wellness initiatives (e.g., communal activities, group therapy, and individual outreach) and working with behavioural health specialists to mitigate the psychological toll of conflict.⁴⁹ Threats to physical wellness included confinement of health professional students, unsafe living or working conditions, outbreaks of infectious disease, malnutrition, and a lack of food and clean water,²³ as well as being the direct target of violence because of their role as future health care professionals.^{25,48} Transportation and safe passage to classes and hospital sites were fraught with peril for students and faculty needing to cross security check-points, neutral zones, or active conflict areas.³¹

Loss of personnel commonly impacted the numbers of students, trainees, and faculty. Faculty and students may be drafted into the military, flee due to safety concerns, or be injured or killed as a result of collateral damage or direct targeting by parties to the conflict.⁴¹ Many published articles describe the attrition of faculty and the lower quality of instruction that ensues,^{41,50} as well as a decreased pool of qualified student applicants.⁴⁴ There were many intervention efforts described to recruit both students and faculty and to maintain the academic calibre of personnel.^{28,32} The reduced number and quality of students matriculating during active conflicts should also be anticipated and flagged for post-conflict mitigation. This is especially noted when the curriculum duration is truncated and revised to meet the needs of combatants over the health needs of the population. The drain on the medical profession may also persist post conflict due to a cycle of migration of health care workers for training and career opportunities outside of their native country.⁵¹

Actions by national governments, the military, and medical organisations served as both a barrier and intervention. These changes can create major barriers to medical education when common barriers involve oversight of medical education such as government regulatory interference in curriculum development and selection of both students and faculty.⁴⁶ Another barrier was governments diverting funds designated for education and public health initiatives over to military funding or banning education and research initiatives altogether.⁴⁷ Interventions included government development of enhanced national standards and organising medical bodies to ensure maintenance of adequate and uniform educational standards.³⁸

3.3 | Success and validation of interventions

There were no studies that attempted to analyse the success, replicate, or validate any of the interventions on our review of the literature.

3.4 | Variation between different types of health care professional trainees

Despite the different trainee categories, the distribution of themes of barriers and interventions identified among the various health professional trainees was similar as demonstrated in Table 1. The most common theme related to interventions among all groups was curriculum, which was also the most common theme among barriers for medical students and residents. Personnel were the most common barrier described for nursing students. Barriers to wellness were less commonly discussed in nursing students and residents as compared to medical students, but interventions regarding wellness were similarly uncommon among all trainees.

3.5 | Temporal differences in barriers and interventions

Half the analysed studies (28) described wars in the modern era and half (28) involved wars in the postmodern era. Themes of barriers and interventions described for health professional trainees varied between the two time periods (Table 3).

The modern era studies identified more barriers in the categories of oversight and personnel (32% and 64%, respectively, compared to 21% and 54% in postmodern era conflicts) with a corresponding increased number of studies addressing interventions in these categories (50% and 54%, respectively, as compared to 29% and 39% in the postmodern conflicts). The postmodern era studies identified more barriers in the categories of wellness, curriculum, and resources (50%, 75% and 57%, respectively, as compared to 43%, 64% and 46% in the modern era) with more interventions in these categories (25%, 79% and 50%, respectively, as compared to 11%, 57% and 39% in the modern era).

TABLE 3 Types of barriers and interventions to maintaining medical education in the modern and postmodern eras

Modern era Themes	Barriers N ^a	Percentage ^b	Interventions N ^a	Percentage ^b
Curriculum	18	64	16	57
Personnel	18	64	15	54
Wellness	12	43	3	11
Resources	13	46	11	39
Oversight	9	32	14	50
Postmodern era Themes	Barriers N ^a	% ^b	N ^a	% ^b
Curriculum	21	75	22	79
Personnel	15	54	11	39
Wellness	14	50	7	25
Resources	16	57	14	50
Oversight	6	21	8	29

^aN is the number of studies including each barrier or intervention theme.

^bPercentage of total number of studies that included each barrier or intervention.

4 | DISCUSSION

The notable findings of this scoping review are the recurrent themes regarding both barriers to maintaining education during times of war and the targeted interventions that have been deployed to overcome them. The overarching themes described were similar despite the type of health professional trainee, diversity in conflicts, duration of conflicts, countries involved, and time periods, suggesting they might provide a useful framework for future research. Such a framework can also enable faculty, school administrators, governmental and non-governmental organisations, researchers, and policymakers to share common understandings of indicators in assessing health care education and to more strategically address educational needs during times of conflict.⁵² The targeted interventions identified in this review have the potential for both positive and negative impacts if replicated in the future. Decreased length of training and increased training in critical care and war time topics increase the health care workforce in the short-term, addressing emergent needs.⁴⁴ In contrast, many of these interventions decrease trainee breadth of experience and exposure, and trainees may not be adequately prepared for treating civilian chronic and primary care maladies in the future.^{18,41} Post conflict efforts need to be implemented to assess these students' clinical competency necessitating remediation of identified gaps in knowledge and skills. Despite interventions to mitigate resource and infrastructure destruction and personnel depletion, medical education is designed around clinical patient care encounters, which must be maintained to provide adequate training but are challenging to maintain in appropriate numbers for learning in war settings.^{41,53,54}

The historical, social, and political context for these conflicts changed dramatically over the study period. Advancements and new frontiers in medical technology, education, and training since the World Wars to the present day are essential considerations. Early in the 20th century, medical education had less structured and fewer

requirements for undergraduate medical education and postgraduate specialty training in regards to length of training, competency-based medical education, governance, duty hour regulations, and certification examinations.⁵⁵⁻⁵⁷ This era predated the existence of accreditation organisations, and most regulations were set at the discretion of individual institutions and medical societies resulting in a wide variability of training duration, proficiency (performance requirements and examinations), and competencies between schools and residency programmes.⁵⁵ The conduct of war also changed from face-to-face combat with clearly defined enemies in the early 20th century, to postmodern era conflicts arising from increased globalisation and interdependence with proxy wars being fought using non-state combatants (e.g., terrorists and insurgents). In addition, these postmodern conflicts featured mechanisation and impersonalisation of weapons (e.g., drones and intercontinental missiles) and the deliberate targeting of health care systems and medical personnel with loss of medical neutrality.⁵⁸ This evolution in medical education and warfare was reflected in differences found in our study regarding the frequency and characteristics of barriers and targeted intervention themes between the modern and postmodern eras.

During the modern era, changes in curriculum focused on shortening training, whereas in the postmodern era, the emphasis was on increased specialisation and longer training including post-graduate and fellowship training. The modern era curriculum shifted to wartime medical topics, whereas in the postmodern era, the curriculum was adapted to reflect medical advancements and technological innovation. To address a lack of personnel, modern efforts focused on recruitment through the military, whereas in the postmodern era, faculty and student recruitment involved international collaborations, employing the internet and global interconnectedness. Lack of resources remained a common barrier but changed over time from books and basic equipment to online resources and technology. The concept of wellness shifted from basic health, personal needs, and

physical safety to psychological wellbeing with more interventions addressing anxiety, depression, isolation, and post-traumatic disorders often experienced by medical trainees in conflict. In general, governments have become less involved in controlling and regulating medical education in postmodern era conflicts and national and international medical organisations are increasingly involved in the oversight and standardisation of health care training.

As communication technology and global interconnectedness have progressed, new innovations such as online education platforms and resources have become prominent mechanisms for maintaining health care education in combination with prior more traditional interventions. It is anticipated that as technology advances globally, these solutions will continue to play an increasingly important role.⁵⁹⁻⁶¹ New technology may also lead to additional barriers (inequitable internet access and suppression of services) and unintended consequences (e.g., security breaches, identification surveillance, and real-time location of platform users).^{62,63}

Many of the interventions described were based on a unique historical context, and the feasibility of these interventions in future wars will depend on the country and circumstances involved. Institutions should be advised to have disaster plans for anticipated challenges but will also need to adapt targeted interventions to maintain health professional education to the individual country and war context.

Despite interventions being replicated in other conflict contexts, our scoping review found no validation or outcome studies for any of the interventions, either in the same conflict or subsequent conflicts. There are challenges to performing this research in conflict settings including security concerns, ethical considerations, potential for bias, lack of funding and resources, lack of a collaborative research environment, and limited research applications.^{58,64} The need for further studies for targeted enabling interventions is a prime area for future research efforts but must be implemented with due diligence, being mindful of these challenges in order to determine which interventions are most helpful and effective for the continuation and completion of health professional training taking into consideration the country context and educational system in place.

4.1 | Limitations

There are several limitations to this scoping review. First, the selection of publications included only English language articles and early (pre-World War II era) research may have missed the dominant language for medical knowledge as it transitioned from German to English during the era of the World Wars. As a result, this might introduce a culturally and geographically biased representation of global efforts to maintain health professional education during times of conflict. The conflicts ultimately included in our analysis from English language journals are typically dominated by authors from the Global North. Our search was primarily in biomedical and educational databases and therefore may have missed articles published in grey literature, history or political journals, or reports from history department archives of medical universities. Some novel educational interventions may have

been missed due to limitations of the search terms. There was a wide range of article types such as original research of varying methodologies, review articles, perspective, commentary, and opinion pieces such that it was not possible to perform a standardised bias or quality assessment of the articles. Articles did not provide consistent demographic data regarding student or trainee age, gender, or race/ethnicity; therefore, no comparative analysis could be conducted on these parameters. The research included a time span where significant advancements in medical and nursing education occurred globally but at varying rates and timeframes. Therefore, results should be considered in the specific historical and political context in which they occurred introducing bias with interpreting results. Given the challenges associated with armed conflict and the difficulty in conducting research, efforts to maintain health professional education likely may not have been documented in written form; records may have been destroyed by war or not published in peer-reviewed literature especially for non-English language speaking contexts. Significantly, there were no studies included that validated specific enabling interventions.

5 | CONCLUSIONS

A scoping review of the barriers and targeted interventions to maintaining health professional education during war was conducted. This scoping review found consistent and predictable overarching categories for both barriers and interventions related to curriculum, personnel, wellness, resources, and oversight. These findings may serve as a useful framework for future research efforts and to strategically support interventions and mitigate the barriers that will inevitably occur during times of war. Any framework based on this analysis must be adapted to the specific geopolitical context and educational structure and technologies of the involved country or region of the world. These efforts are specifically not designed for countries planning to engage in conflict. This framework may also be extrapolated to non-conflict disruptions in medical education such as natural disasters or wide-spread disease (such as the COVID-19 pandemic). The applicability and generalizability of this analysis to non-conflict situations merits further research.

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CONFLICT OF INTEREST

TBE is funded by NIH R44DA051106 and the Massachusetts Consortium for Pathogen Readiness (MassCPR). TBE has a financial interest in Biobot Analytics. TBE's interests were reviewed and are managed by Brigham and Women's Hospital and Mass General Brigham in accordance with their conflict of interest policies.

ETHICS STATEMENT

This study was approved by the IRB Approval Protocol #:2019P000131 Brigham and Women's Hospital/Partners Healthcare.

AUTHOR CONTRIBUTIONS

VD, AF, PP and TE were involved in the study concept and design; VD, MS, BA, BT, TE and AF were involved in the acquisition of data; VD, RD, MS, BA, BT and TE were involved in the data analysis and interpretation; RD and MS developed data figures and tables; VD and MS were involved in thematic coding and qualitative data analysis and manuscript draft writing; VD, MS, TE, RD, AF and PP contributed to critical revision of the manuscript for important intellectual content.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

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